

opposing sides of the strap 20 defining the opening 26. Further, the flutes 39 preferably alternate directions around axis 37, so that the adjacent flutes 39 extend on opposing sides of the strap 20. Thus, the flutes 39a are on opposing sides of the strap 20 from the flutes 39b.

[0059] As shown in Figure 2, there are six flutes 39. As few as four flutes 39 are believed possible. To preserve the alternating pattern of flutes 39 as described above, there are advantageously an even number of flutes 39, such as 4, 6, 8, 10, 12, etc, but an odd number could be used if other considerations were deemed more important than the alternating pattern. The openings 26 in Figure 1 are shown with 8 flutes, while Figures 2-3 show six flutes 39. Between 6 and 8 flutes 39 are believed to comprise a good trade-off between increasing the support for the tubing 22, and avoiding a support that is so thin that it damages the tubing 22 - as discussed later. Eight flutes 39 are preferred.

[0060] Referring to Figures 4-6, embodiments are shown that have flutes 39 that alternate in the direction in which they are offset from the plane containing longitudinal axis 27 of strap 20, but with discontinuities in the transitions between adjacent flutes. The edges of base 40 do not abut the edges of the adjacent base 40 of adjacent flutes 39. This results in portions 44 of the undeformed periphery of the opening 26 being placed intermediate the adjacent bases 40 of the adjacent flutes 39. Thus, the undulating edge 38 is formed by undulating bases 40 of alternate flutes 39, and intermediate portions 44 interposed between adjacent bases 40. In the embodiment of Figures 1-3, the undulating edge 38 is formed by undulating bases 40, which abut one another.

[0061] Further, in the embodiment of Figures 4-6, the undulation is not as curved, but is more angular and straight sided. Making the undulations of edge 38 more curved minimizes stress concentrations. The flutes 39 preferably extend on both sides of the plane of the strap containing the longitudinal axis 27. The openings 26 in Figure 4 are each shown with eight undulating flutes 39, while Figures 5-6 show six flutes. Other numbers of flutes are possible.

[0062] Referring to Figure 1, in use, a strap 20 containing one or more openings 26 is fastened to one or more studs 24 by fasteners 30 such as nails extending through holes 28 that align with the stud(s). The tubes 22 are then placed in appropriate openings 26. Alternatively, the openings 26 can be placed over the pipes or tubing 22, and then the fasteners 30 inserted through the appropriate holes 28 to fasten the strap 20 to the stud or studs 24. The undulating edge 38 provides

an increased support for the tubing 22. The tubes 22 can be bonded to the strap by solder or adhesives, or just rested against the undulating edge 38 of the strap 20.

[0063] Referring to Figs. 9a, 9b, preferably, the deformation forming the undulating edge 38 maintains the edge 38 parallel to the axis 37 as reflected in Figure 9a, rather than angling the edge 38 relative to the axis as shown in Fig. 9b. Having the edge 38 parallel to the axis 37 provides for increased surface area contacting the tubing 22 inserted in the opening 26.

[0064] Referring to Figures 9a, 9b, the distance that the base 40 is offset from the plane of strap 20 in which the opening 26 is located will affect the amount of increase in the support to the tubing 22. But as the periphery of the opening 26 is deformed, it tends to decrease in thickness and it tends to rotate so that a corner of the periphery is oriented toward the center line 37, as shown in Figure 9b. Further, even if the undulating edge 38 is maintained parallel to the axis 37 and parallel to the abutting side of the tubing 22, the formation of the flutes can cause the peripheral edge 38 to be thinner than the strap 20. Described another way, as the undulating edge 38 is deformed to form base 40 it can become narrower or thinner than the undeformed portions of strap 20. Thus, intermediate portions 44 can be thicker than the center of base 40.

[0065] Either the angling of the edge 38 or a reduction in the thickness of the edge 38 can tend to cut or abrade the abutting portion of tubing 20. Thus, there is a trade-off between the amount of the disruption of the base 40 from the plane of the strap 20 containing the opening 26, and the potential for abrasion or damage to the tubing 22 abutting the deformed base 40. Further, a reduction in the thickness of the edge 38 provides less bonding area for adhesive or solder to retain the tubing 22 in the opening 26. The 1/16 inch offset to each side of strap 20 is believed to provide an acceptable compromise for use with drywall and plumbing straps to retain water pipes.

[0066] Referring to Figures 10-11, the flutes 39 need not be triangular, but may be of other shapes such as oval, elliptical or circular, and the cross-sectional shape need not be triangular as in Figures 5-6, but could be curved as in Figures 2-3. Figures 10-11 show a strap 20 with four flutes 39, each having an elliptical outer shape, and a curved, preferably elliptical cross-sectional shape. As in the other illustrated embodiments, the flutes 39 each have a base 40 on the peripheral edge 38, and an apex or smaller end 42 outward of the opening 26. The length of the base 40 of the ellipse that forms the peripheral edge 38 is shown as smaller than the length of the intermediate portions

44. Advantageously, the length of the base 40 is greater than the length of the intermediate portions 44, preferably much greater. Ideally, the ends of bases 40 of adjacent flutes 39 abut so the intermediate portions 44 are small relative to the length of a base 40.

[0067] Referring to Figures 1 and 10-11, the flutes 39 in Figures 10-11 are shown with their bases 40 located either adjacent and parallel to the long edge of the strap 20, or along what would normally be the vertical axis if the fluted opening 26 is on a horizontal plumbing strap that has its opposing ends fastened to two adjacent studs 24 as shown in Figure 1. Phrased another way, the pattern of flutes 39 in Figures 10-11 has a longitudinal axis that runs along section lines 11-11 in Figure 10, and that longitudinal axis is not perpendicular to an adjacent edge of the strap 20. That orientation of the flutes 39 directs the longitudinal axis of a pair of flutes toward the side of the strap 20. This orientation requires a wider strap, which uses more material is heavier and costs more money. There are thus advantages to orientating the flutes 39 so they are symmetrically located about the vertical axis but not on the vertical axis. Thus, for example, the flutes 39 in Figure 1 have the apexes 42 of the flutes oriented offset from the vertical axis, but symmetric with respect to the vertical axis. The same is true of flutes 39 in Figures 2-6.

[0068] To make the strap 20 with the fluted openings 26, a strip of material, preferably metal, is punched to form openings 26, except to a diameter somewhat smaller than the ultimately intended dimension, to minimize the area of material which must later be displaced during the formation of the flutes. At the same time, the fastener holes 28 are formed. Then the strap 20 is stamped to form flutes 39 of the desired size and shape around the periphery of the openings 26, which remain smaller than their final diameter. Finally, while capturing and holding the flutes 39 securely, the openings 26 are then punched to their final diameter, to ensure they conform to the shape of the outer periphery of the tubing 22, which is typically circular.

[0069] In more detail, the undulating edge 38 can be formed by placing two mating dies on opposing sides of a flat strap 20, and deforming the strap. A two stage die is probably most useful for the stamping. Each of the dies will have the desired shape of the resulting flute 39 in the die. Thus, one die will have the shape of the flutes 39 conforming to one side of the strap 20, while the other dies will have the shape of the flutes 39 on the opposing side of the strap. When the two die abut, they are separated by the shape and thickness of the resulting strap 20 containing the formed